

Closing Thu: Intro to Webassign

Closing Tue: Sup. 1-3, Sup. 4

Plan to complete the HW at least TWO days before it closes. You need time to ask questions and you won't have it if you wait until 1 day before.

Entry Task: Use the Dist vs Time graph from lecture 1. Estimate the average speed from 20 to 25 as follows:

1. Draw and extend out a line thru $t = 20$ and $t = 25$ on the graph.
2. Use two "easy to read" points on the line to compute the slope.

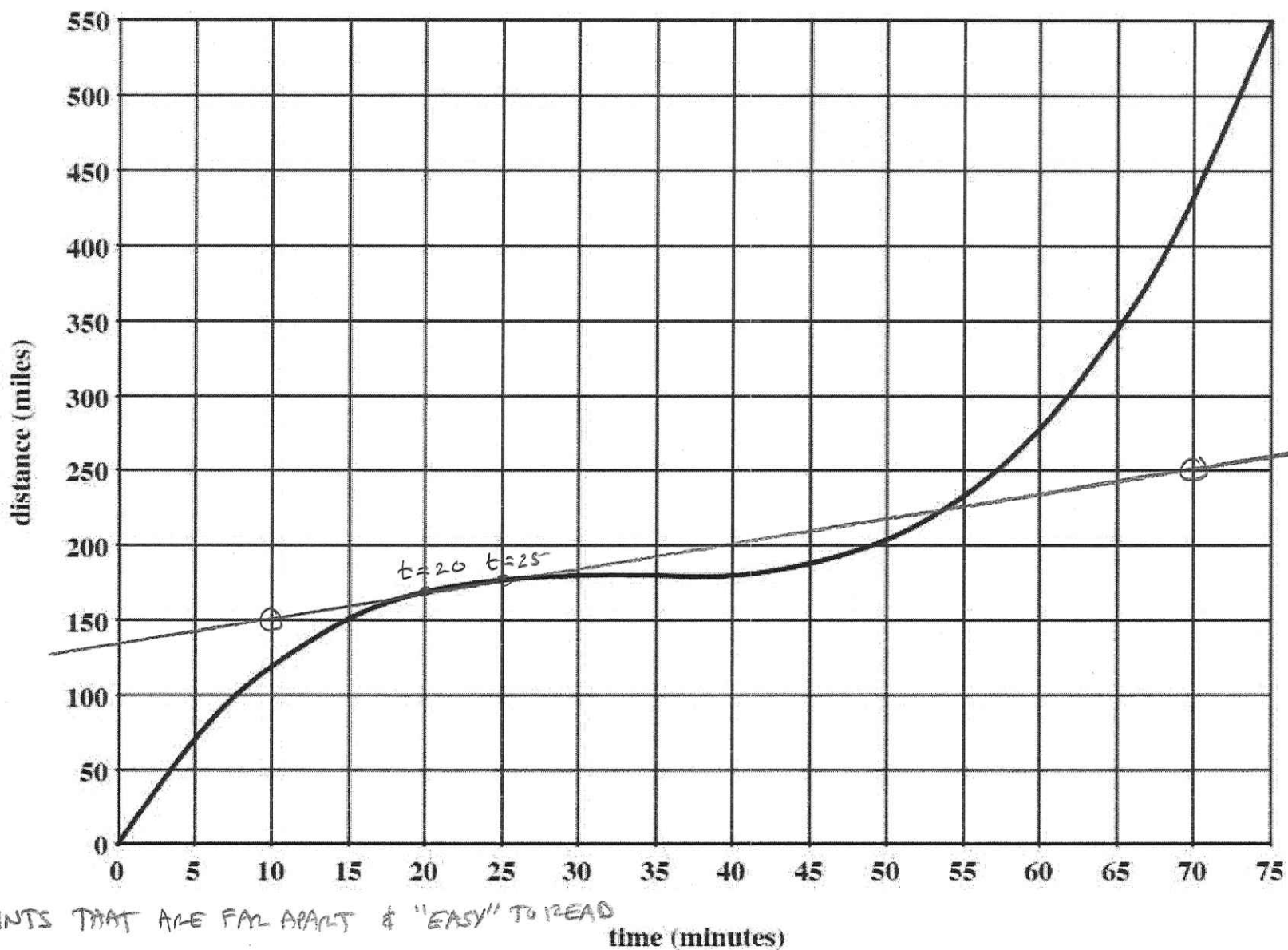
Recall: Slope of a line = $\frac{RISE}{RUN} = \frac{y_2 - y_1}{x_2 - x_1}$

$$\text{AVERAGE SPEED} = \frac{\text{CHANGE IN DISTANCE}}{\text{CHANGE IN TIME}}$$

HARD TO ACCURATELY ESTIMATE FROM GRAPH

IT IS MUCH MORE ACCURATE TO REALIZE THIS IS THE SAME AS THE SLOPE OF A LINE. THEN DRAW THAT LINE AND USE ANY 2 PTS ON THE LINE TO COMPUTE THE SLOPE.

$$\text{AVE. SPEED} \approx \text{slope} = 1.\bar{6} \approx \boxed{1.667 \frac{\text{miles}}{\text{min}}}$$



ENTRY TASK

- ① DRAW LINE THRU GRAPH AT $t=20$ AND $t=25$

- ② FIND TWO POINTS THAT ARE FAR APART & "EASY" TO READ

HOW ABOUT $(10, 150)$ AND $(70, 250) \Rightarrow \text{slope} \approx \frac{250 - 150}{70 - 10} = \frac{100}{60} = 1.\bar{6}$

Summary/Terminology

Overall rate:

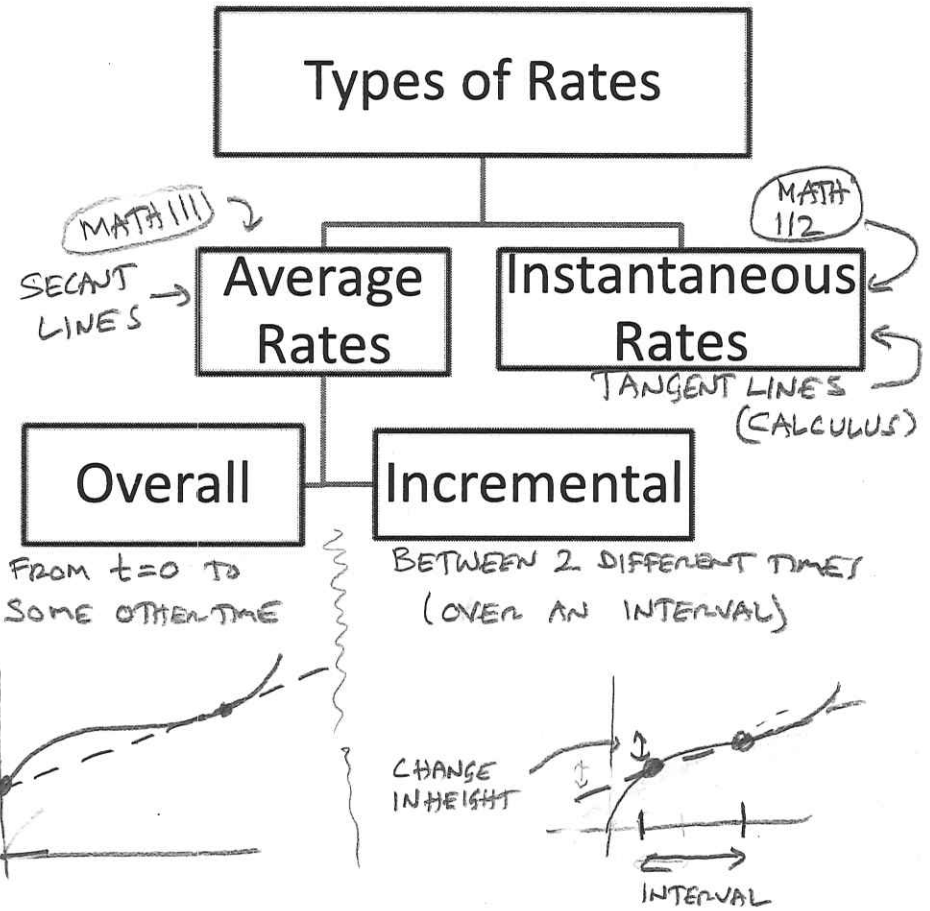
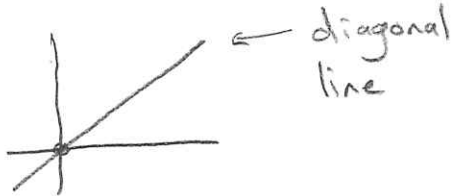
$$\text{ATS} = \text{average trip speed} = \frac{\text{Total Dist}}{\text{Total Time}}$$

Incremental rate:

$$\text{AS} = \text{average speed} = \frac{\text{Change in Dist}}{\text{Change in Time}}$$

Graph Terms

- A secant line is a line through two points on a curve.
- A diagonal line is a line through the origin.



Lesson 2 in reading graphs

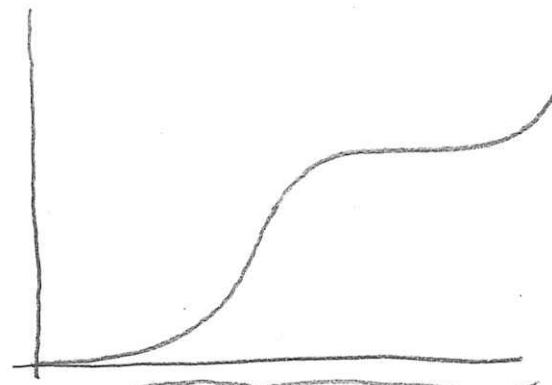
- If given a total distance graph and asked about speed/rates, **get your ruler out** and draw lines.

Use points far apart and easy to read to find the slopes of the lines.
(Most of the HW this week)

- If given a graph that has increments or rates, **put your ruler away**. Read off values from the data and use a table.
(Supp. 1-3/2, Supp. 4/1,3)

Ex] Supp. 4/2

TOTAL WATER THAT HAS GONE OUT OF RESERVOIR



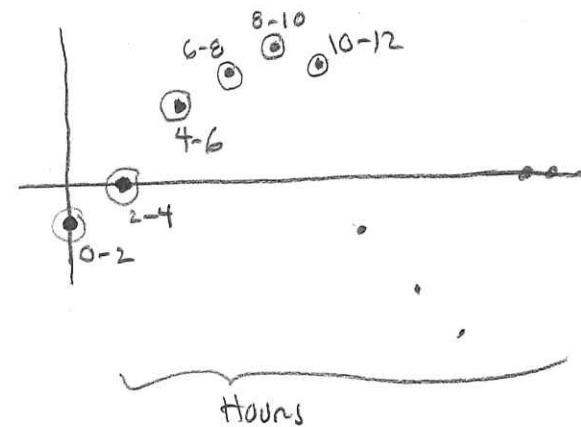
- (a) OVERALL RATE AT 5 AM
→ DRAW SECANT FROM 0 TO 5, COMPUTE SLOPE.

- (d) GIVEN A RATE IN OF 100 gallons/hr AND STARTING WITH NO WATER, WHEN DOES SHORTAGE BEGIN?
→ DRAW A DIAGONAL LINE WITH SLOPE 100. WHEN IS WATER IN EQUAL TO WATER OUT.

Ex] Supp. 4/3

increments → CHANGE IN TEMP

MAKE A TABLE!!!



TIME	0	2	4	6	8	10
TEMPERATURE	??					
		-1°F	+0°F	+1°F	+1.5°F	+2°F

- (a) CHANGE IN TEMP FROM 6 TO 10
6-8 : UP 1.5°F
8-10 : UP 2°F } **3.5°F**

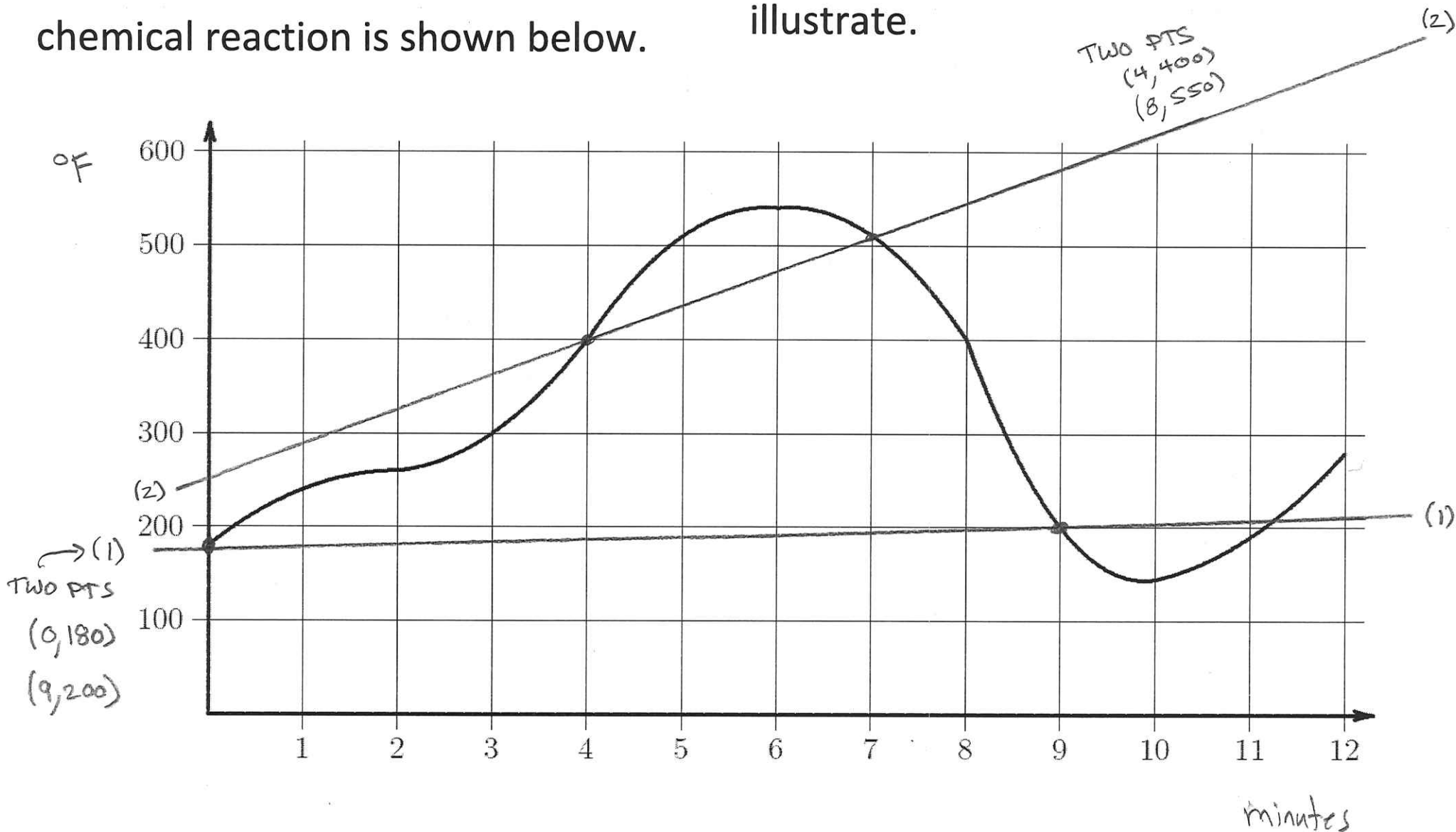
- (b) TEMP HIGHER AT 10 OR 12?
10-12 : UP 1.75°F

HIGHER AT 12

Supplement 3-4 (Reference Lines)

Temp (in °F) vs. time (in min) for a chemical reaction is shown below.

We will answer the five main types of rate questions using this graph to illustrate.



Warm up questions:

1. Find the overall rate of change after 9 minutes?

- DRAW LINE THRU GRAPH AT $t=0$ and $t=9$.
- ESTIMATE TWO POINTS ON LINE $\begin{cases} (0, 180) \\ (9, 200) \end{cases}$
- COMPUTE SLOPE (RATE).

$$\text{SLOPE} = \frac{200 - 180}{9 - 0} = \frac{20}{9} \approx \boxed{2.22 \frac{\text{°C}}{\text{min}}}$$

Note: Overall Rate means starting from wherever the graph starts (not necessarily the origin)

↙ SPEED (RATE)

2. How fast does the temp rise, on average, during the 3-min interval beginning at $t=4$ min?

$$t=4 \text{ to } t=4+3=7$$

- DRAW LINE THRU GRAPH AT $t=4$ and $t=7$
- ESTIMATE TWO POINTS ON LINE $\begin{cases} (4, 400) \\ (8, 550) \end{cases}$
- COMPUTE SLOPE (RATE)

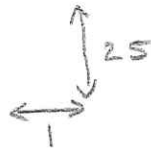
$$\text{SLOPE} = \frac{550 - 400}{8 - 4} = \frac{150}{4} = \boxed{37.5 \frac{\text{°C}}{\text{min}}}$$

How could we answer these?

3. Find a time at which overall rate of change of temp is 25 deg per min.

GIVEN A RATE!
WORKING BACKWARD!

- DRAW A REFERENCE LINE WITH SLOPE 25.



$(0,0), (1,25), (2,50), (3,75), \dots, (10,250)$

- SLIDE RULER PARALLEL TO THE REFERENCE LINE UNTIL IT IS TOUCHING THE STARTING LOCATION ON GRAPH

- FIND OTHER INTERSECTION

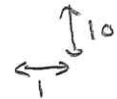
$$t \approx 8.1 \text{ min}$$

SO FROM $t=0$ TO $t=8.1$
THE RATE IS ABOUT $25 \frac{^{\circ}\text{C}}{\text{min}}$.

4. Find a two-minute interval during which the incremental rate of change is 10 deg/min.

GIVEN A RATE!

- DRAW A REFERENCE LINE WITH SLOPE 10.



$(0,0), (1,10), (2,20), \dots, (10,100)$

- SLIDE RULER PARALLEL TO THE REFERENCE LINE UNTIL IT IS TOUCHING THE GRAPH AT TWO LOCATIONS WHICH ARE 2-MIN APART.

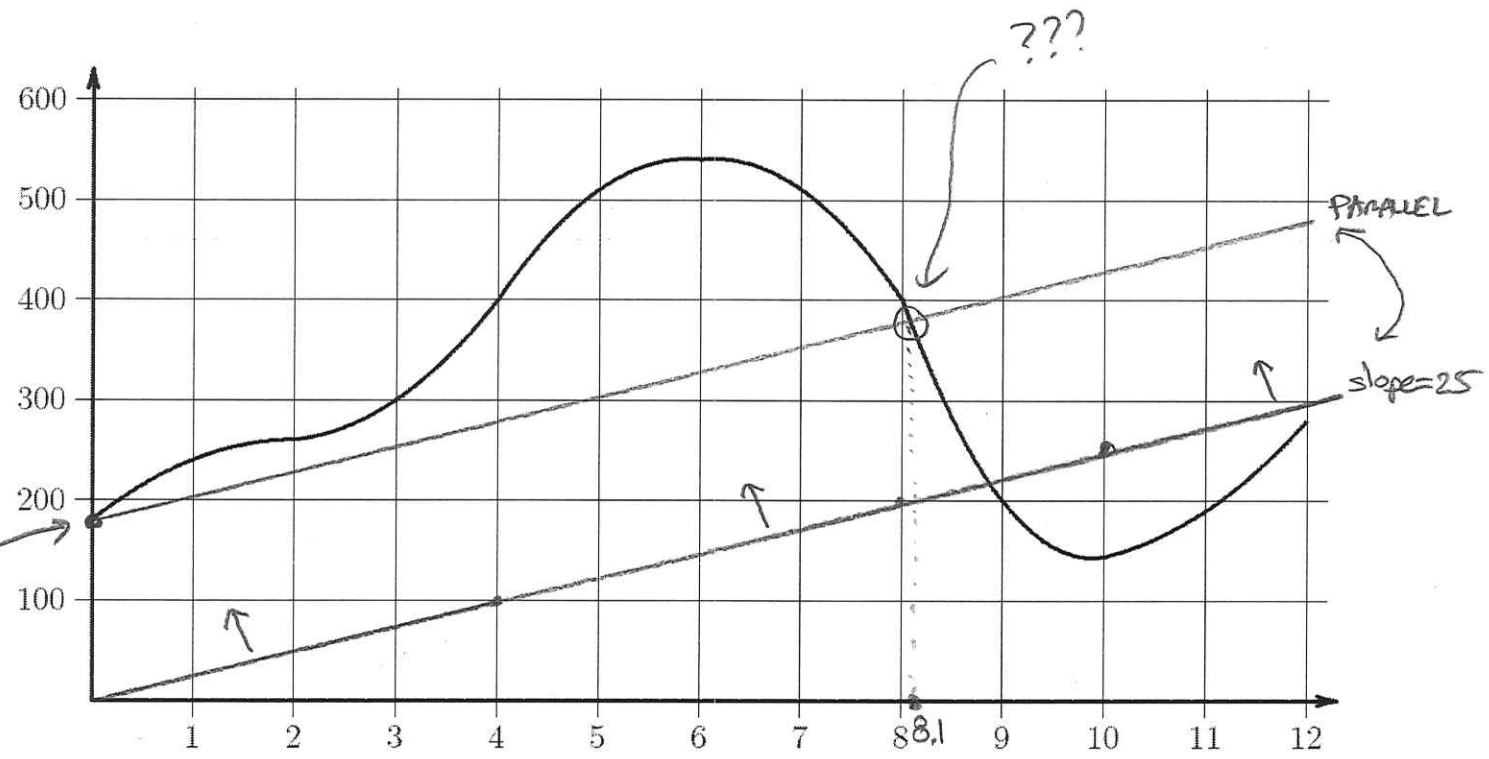
- TWO ANSWERS!

$$t \approx 4.8 \text{ TO } t \approx 6.8 \text{ min}$$

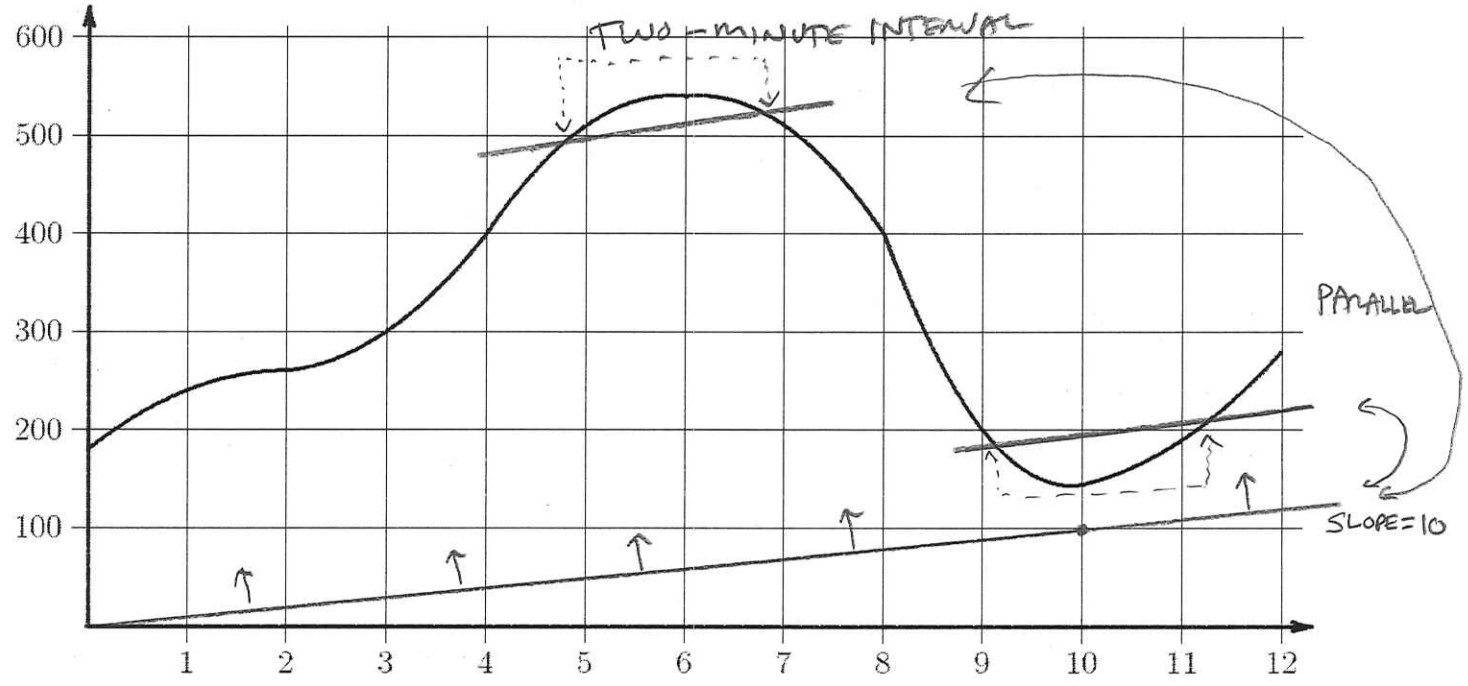
$$t \approx 9.1 \text{ TO } t \approx 11.1 \text{ min}$$

DRAW A REF. LINE
WITH SLOPE 25
 $(0,0), (1,25), (2,50), \dots, (10,250)$

MORE HERE BECAUSE
QUESTION IS ABOUT
OVERALL RATE.

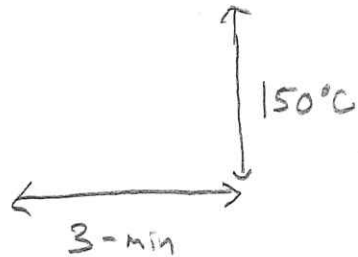


DRAW A REF. LINE
WITH SLOPE 10
 $(0,0), (1,10), (2,20), \dots, (10,100)$



5. Find a three-minute interval during which the temp rises by 150 deg.

WANTS

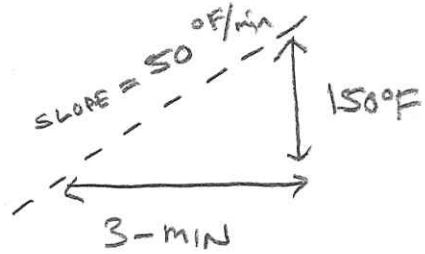
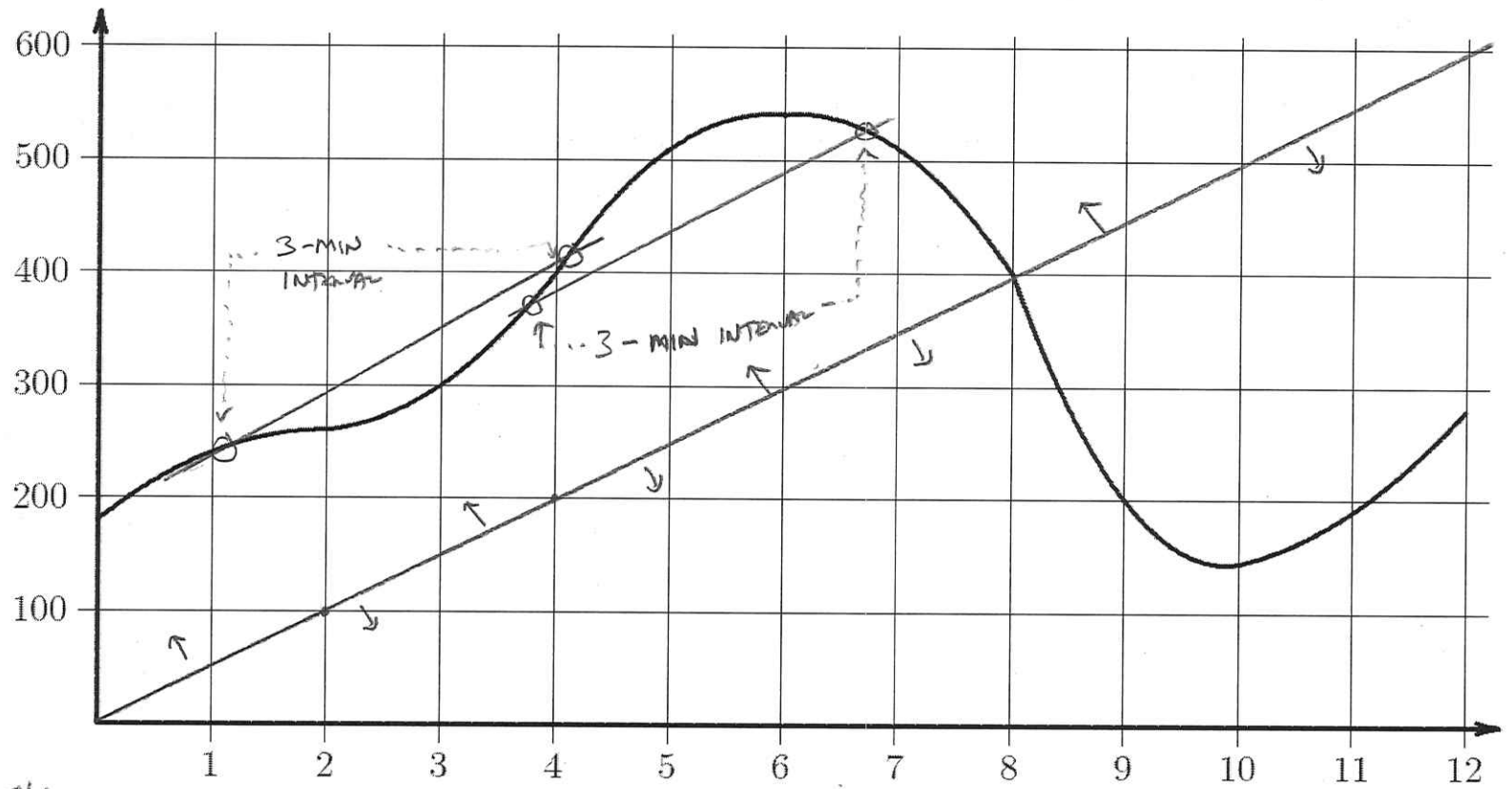


SO GIVEN RATE = $\frac{150^{\circ}\text{C}}{3 \text{ min}} = 50 \frac{\text{C}}{\text{min}}$ & WANT A 3-MINUTE INTERVAL

- DRAW REFERENCE LINE WITH SLOPE 50 $(0,0), (1,50), (2,100), (3,150), \dots$
- SLIDE RULER PARALLEL TO THE REFERENCE LINE UNTIL IT IS TOUCHING THE GRAPH AT TWO LOCATIONS WHICH ARE 3-MIN APART.

TWO ANSWERS

- $t \approx 1$ to $t \approx 4$ min
- $t \approx 3.7$ to $t \approx 6.7$ min



• DRAW REFERENCE LINE WITH SLOPE 50
 (0,0) (1,50) (2,100), ... (4,200)